Utilizing High-Resolution Water Vapor Imaging (7.3 µm) to Estimate Industrial Activity More Accurately than Thermal Analytics Alone

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Introduction

For military-related industrial processes such as smelting (critical for a variety of activities ranging from the manufacture of artillery shells to tanks to steel beams for new building construction,) our own military intelligence uses the thermal signature of factories to estimate their level of activity, schedule of operations and likely function.

Although useful, thermal output does not tell the entire story of industrial activity. A furnace meant for smelting might be active 24 hours per day but only be used for producing steel for as little as 8 hours of that time. In a contest based upon which side can produce the most artillery shells, for example, one needs to accurately assess the maximum productive capacity of a given smelting plant in order to make appropriate plans for the construction of one's own factories in order to ensure a production advantage. Thermal output does not convey sufficient information to allow for an accurate inference of any factory's productive capacity. Furthermore, factories at which workers sleep in dormitories preclude the assessment of vehicle parking as a means of estimation of the number of workers employed on a given day, meaning that traditional photographic reconnaissance methods can also fail to provide a complete picture of industrial activity.

For industrial activities which do not involve the generation of substantial thermal output, there is often little means of gauging activity levels. In these cases, an alternative means of evaluation of activity would prove useful for the purposes of military intelligence gathering.

Abstract

Particularly in the case of smelting operations in which water is necessarily utilized in order to facilitate the necessary rapid cooling of steel (an essential step in its production,) a great deal of moisture is released into the ambient atmosphere as a result of this water usage. The amount of steam generated through such a process could be used to directly and accurately infer the cubic volume of steel being produced in a given time period. Furthermore, more subtle differences in water vapor injection into the atmosphere associated with activity related to the presence of human beings in contexts other than vapor-intensive activities such as smelting could yet be exploited in order to gauge human activity levels.

Although the evidence of water usage is most apparent and easy to detect using water vapor imagery in the case of smelting activities, given the availability of advanced sensors, light of 7.3 μm in wavelength can also be used to create images of sufficient resolution to accurately detect more subtle variations in water vapor release into the atmosphere associated with light industrial and even non-industrial activity. Although this light is longer in wavelength than visible light and lends itself to comparatively low-resolution imagery, this deficit can now be overcome (particularly given that one only needs to estimate the concentration of water vapor and does not need to judge color, for example) over areas hundreds of feet in width about 100-200 feet AGL. Beyond more accurate light-sensing, airflow patterns must be taken into account in order to enable such a process, but this is well-within our capabilities. Accurate assessment of human-associated water vapor deposition into the atmosphere would ideally involve taking measurements on days when the wind speed is negligible.

The primary source of human-associated water vapor injection into the atmosphere is not, as some would expect, the flushing of toilets (this tends to inject water into the ground at sufficient depths so as not to lead to evaporation, although there are some exceptions) but rather the moisture injected into indoor environments through pulmonary respiration.

A single human being secretes, through ordinary respiration, the equivalent of about one fluid ounce of water per hour into the ambient atmosphere. This subtle variation in water vapor content within the micro-climate of a single building (industrial or other) could be sufficient to enable the inference of the presence of an increased number of humans within a structure. Eventually, a door is opened and the water vapor from within the building makes its way into the atmosphere at large. Sensors of sufficient resolution would be capable of detecting variation in water vapor associated with the denizens of a building which ordinarily hosts 100 dayshift employees (in desk-jobs such as cryptanalysis, for example,) temporarily playing host to 150-300 such employees. The absolute humidity of such an environment could be expected to increase proportionally. Not only do activities such as human respiration lead to the injection of moisture into the ambient environment, activities such as the preparation of food lead to the generation of humidity. Even people working in intelligence need to eat food to survive. All buildings featuring galleys, including the most secure buildings involved in intelligence work, have a need to vent cooking fumes directly to the exterior of the building. Frozen beef products such as hamburgers and other products often prepared in workplace cafeterias often include large amounts of water which is "cooked off" during the preparation process. If an intelligence agency which ordinarily employs 100 workers were to kick into high gear and suddenly employ double that amount, they would also, necessarily, prepare double the amount of food and thus, release double the amount of water vapor into the atmosphere from this source, alone.

To the extent that air conditioning systems are employed, these systems would only make water vapor assessment of activity a more straightforward process as most air conditioning systems simply dump collected moisture through a sieve on

the outside of the compressor units which may be linked to drains which run to the surface and not to the sewer.

Regardless of season, human pulmonary activity (and human activity, generally) leads to the injection of measurable water vapor into the atmosphere which, in gatherings of 100 or more, can be usefully quantified in order to make assessments of unusually high activity levels in any area.

Conclusion

Efforts should be made to enhance our capacity to measure water vapor content in the atmosphere for non-meteorological purposes as water-vapor analysis, if utilized properly, would be a boon to military intelligence.